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Non-Proliferation and Assurance of Supply

Recent Models of International Nuclear Cooperation

Volume I: Summaries

by

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Chr. Schlupp and G. Stein

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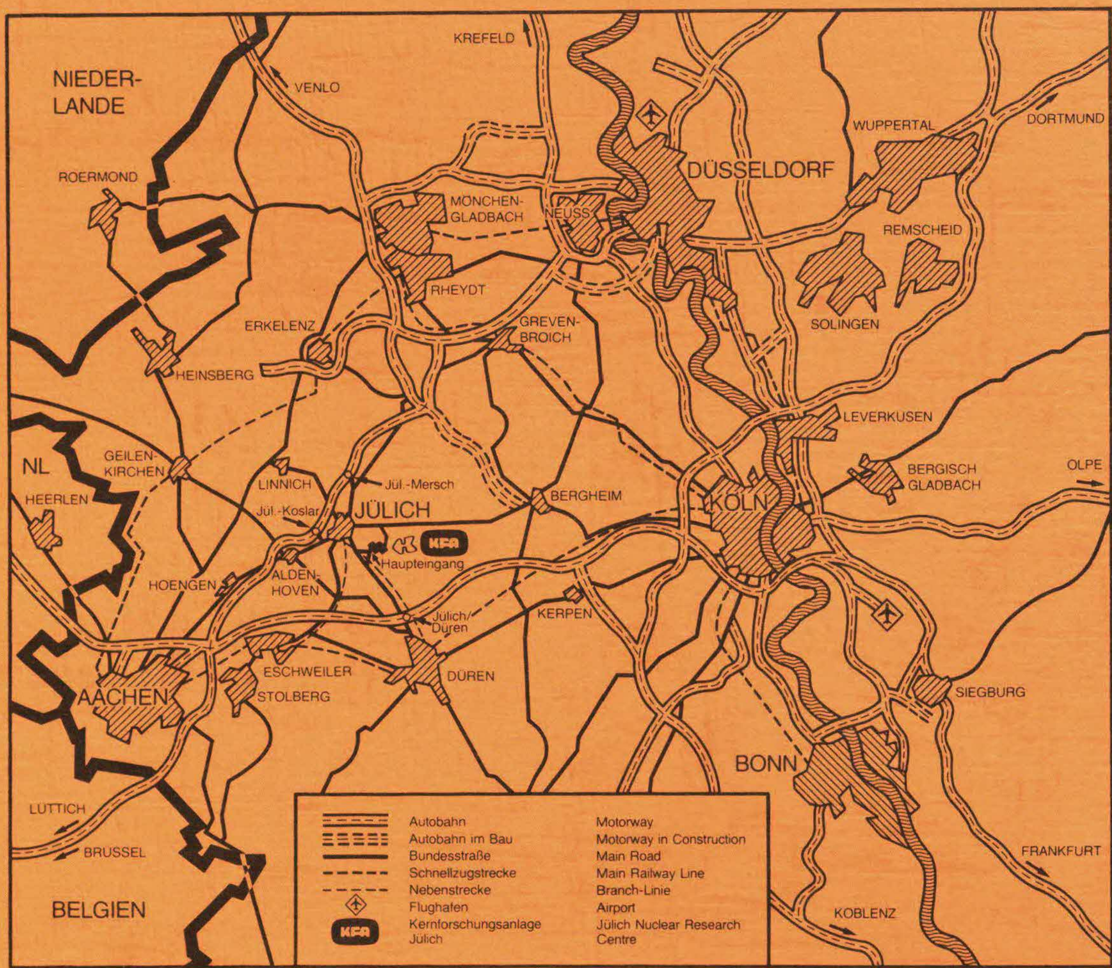

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Note for the reader

This report Jül-Spez-188
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CONTENTS

1. Introduction

The necessity of exploiting all available sources of energy all over the world also makes the increased implementation of the peaceful uses of nuclear energy (quite) indispensable. In future not only the industrialized countries but also the developing countries will have to make use of nuclear energy increasingly. These understandable efforts on the part of the countries of the Third World to have a share in utilizing nuclear energy must however draw a response from the industrialized countries in such a way that an institutional framework be created which will serve both the aim of non-proliferation and also an assured energy supply. In the past, also cooperation between industrialized countries within the framework of institutional models has proved successful.

This study intends to investigate institutional models which, if applied in the nuclear fuel cycle, could do justice particularly to these two aspects. The following comments reflect the authors' opinion and represent a frozen picture of the position at the end of 1980 which was obtained in various discussions with experts on a national and international level.

If one considers the historical development of these models then there were initially intensive efforts in the 1960s to prevent the further proliferation of nuclear weapons by fixing the status quo in the field of nuclear weapons. According to Article VI of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) states should aim at reducing their weapons potential. An appropriate path towards this objective for the non-nuclear weapons states was thought at that time to be that they should refrain from constructing atomic weapons, but on the other hand that they would be unimpeded in the field of the peaceful uses of nuclear energy, indeed that they would be supported by the nuclear weapons states in the peaceful application of nuclear technology. This carefully balanced compromise was reflected in the Non-Proliferation Treaty of 1968. This Treaty was ratified by more than one hundred nations in the following years and was held to be a consolidation of a situation regarded as menacing in many parts of the world. These problems took a new turn with the detonation of the Indian nuclear explosive device in May 1974. In particular Canada, Australia and the United States took this event as an occasion to reconsider the consensus achieved within the NPT. The result was the intention of more strictly delimiting the peaceful uses of nuclear energy, particularly in the field of the so-called sensitive activities, such as enrichment, reprocessing and the utilization of high-enriched uranium.

The new phase in non-proliferation policy triggered by this development led, via a large number of suggestions and measures, to the initiation of the International Conference on Nuclear Fuel Cycle Evaluation (INFCE). This conference, terminated at the beginning of 1980, came to the result that there are effective measures for containing proliferation without impairing the development of nuclear technology for energy supply. The central conclusion from INFCE of not merely regarding proliferation as an isolated technical problem but of including it in a country's political environment, led to the consideration of countermeasures in order to reduce motivation for proliferation by guarantees in the field of assurance of supply. These dual aspects in nuclear energy - assurance of supply and non-proliferation of nuclear weapons - are not new. Elements of assurance of supply and aspects of an unrestricted exchange of technologies and materials for the peaceful uses of nuclear energy, together with effective safeguards for nuclear material, were already taken into consideration in the EURATOM Treaty and indirectly also in the NPT. However, the significance attributed by INFCE to coupling non-proliferation and assurance of supply is indeed remarkable and was manifested in a special working group for assurance of supply. The INFCE consultations were terminated in February 1980 and found a continuation in the Committee on Assurance of Supply (CAS) at the IAEA, which has the task of working out solutions capable of finding a consensus for basic questions of international nuclear relations by cooperation between all interested nations:

- on one extreme a group of developing countries outside the NPT: on the Indian subcontinent India and Pakistan, in South America Argentina and Brazil; and also some signatory states to the NPT such as Yugoslavia, the Philippines and Egypt,
- on the other extreme a group of western nations (Austria, Australia, Canada, Denmark, Norway, the Netherlands, New Zealand, Sweden, Finland),
- and in the middle the USA, Belgium, Switzerland, the Federal Republic of Germany, Spain, France, Italy and Japan.

Within each group finer differences of opinion also exist.

From among the many conceivable possibilities of improving assurance of supply with a simultaneous reduction in the danger of proliferation, institutional mechanisms in the form of international cooperation were regarded by the INFCE as suitable. These considerations were based upon the idea that credible guarantees for the front and back end services were of particular significance for the growing number of nations who felt compelled to use nuclear energy to cover their energy requirements. This is supported by the fact that the technological infrastructure of these nations can hardly meet demands when crossing the threshold to the peaceful uses of nuclear energy. In this way an institutionalization of multinational cooperation can combine the interest of the individual nations in an assured supply with control of proliferation.

Several features of such institutional mechanisms for international cooperation will be sketched in this study and investigated with respect to their value for preventing proliferation as well as their quality concerning assurance of supply. The models presented for discussion in this context are

- International Emergency Agreements
- International Nuclear Fuel Bank (INFB)
- Regional Fuel Cycle Centre (RFCC)
- International Spent Fuel Management (ISFM)
- International Plutonium Storage System (IPS).

These models were selected because they play a special role in the post-INFCE phase and have also already been discussed and evaluated in part in an international context, particularly at the IAEA. It can be presumed that in future these areas will also be priorities in CAS debates.

For reasons of clarity and due to the extensive material, the study is presented in three parts. The first part is a summarizing representation and break-down of all the work. The second part describes the results of investigations into emergency supply mechanisms at the front end of the fuel cycle (International Emergency Agreements and INFB), and the third part presents the Regional Fuel Cycle Centre (RFCC) as well as models for the back end of the nuclear fuel cycle (ISFM and IPS).

2. Summaries

2.1 Front End

2.1.1 International Emergency Agreements

This study is concerned with mechanisms for intergovernmental planning in the international uranium market. Particular aspects of a possible supply system are presented in the form of an emergency network in the case of failure of delivery in the uranium supply sector. The primary idea of a uranium network is based (in the first instance) on the perception that on the one hand nuclear energy plays a significant role in world energy supply but on the other hand only a few nations have sufficient uranium deposits at their disposal. Those nations operating nuclear energy who do not have their own uranium supplies are therefore justifiably interested in assuring their uranium supply in the case of emergency. On the other hand, it is in the interest of the international community to prevent the further proliferation of nuclear weapons with the aid of generally accepted NP principles. We are therefore concerned with the realization of institutional possibilities with respect to cooperation which can increase confidence, at the same time offering an effective control of non-proliferation, and make a considerable contribution to assuring the supply of participants as determined at that time by CAS and demanded in the INFCE.

At the front end interruptions in the production of natural uranium, conversion, enrichment and in fuel element fabrication, as well as in the necessary transportation between the individual stages, can occur if uranium is no longer available in sufficient quantities for various reasons. The reasons for failure of the uranium supply can be of a technical, political or commercial nature. They can however also be brought about by natural catastrophes. Furthermore, technical deficiencies, strikes, a sudden change in the uranium exporting or importing countries' policy, a tightening of the export or investment policy of the supplier countries can also lead to interruptions in supply.

In the Appendix, this part of the study contains a comparative investigation "Joint Approaches to Multilateral Agreements Between Producer and Consumer Nations in the Field of International Raw-Material Laws".

The study is divided into the chapters "Assurance of Supply within the Framework of a changing World Trade System" (description of the model, structural questions concerning an emergency agreement, determination of function and stocks, the initiators' political objectives), "Network or Sharing System (Agreement)", "Individual Elements of an IEA Model", "Details of a Network", (1) "Elements of an Agreement between the Holders of the Uranium Industry", (2) "Elements of an Intergovernmental Arrangement Concerning a Network Agreement". The elements of a uranium network could comprise the following areas:

- uranium emergency pool,
- emergency supply trigger with an institutional structure for the decision-making mechanism,
- conditions for participation and accession, as well as
- budgeting.

The basic differences between the IEA model and a network are first of all elucidated. The private (or governmental) holders of the uranium industry are envisaged as contracting parties in a network, whereas the IEA model presumes an agreement between the nations involved under international law.

A further difference is that the network can hand over implementation of the agreement to the uranium industry to a large extent, whereas the IEA model involves governmental authorities to a higher degree.

This difference is of significance for storage. In the case of national stores considerably higher costs would result than in storage by private industry since the latter operates these stores anyway.

In contrast to this a significant disadvantage of a network would be that the civil agreements on which it is based would be allocated to systems of national legal order which, for their parts, would be at the disposal of the participating states.

In its classification, the study prefers the non-binding, institutionally more flexible network model. However, it also draws attention to the fact that a too laxly conceived model can not be regarded as desirable.

The starting point for the whole idea of an emergency arrangement has to be the consideration that in case of emergency sufficient assurance is guaranteed to the needy party.

In conclusion, the study suggests that a network should be created by a civil agreement between the holders of the uranium industry. Its functioning should be ensured by an agreement under international law between the nations involved.

Regardless of the advantages of a network design, the choice between a network or the IEA model is however in the last analysis based on politically determined criteria which are also influenced by the course of the international discussion.

2.1.2 International Nuclear Fuel Bank (INFB)

The concept of an INFB is investigated in a general and an individual valuation according to the main problem areas (1) proliferation inhibition, (2) political independence, (3) assurance of supply, (4) assurance of planning, (5) economic efficiency, (6) technology transfer, (7) health, safety and environment, (8) political and social acceptance for the host country, (9) capability to sanctions and (10) regulative relevance. In describing the model, details of the internal structure are given (including aspects of financing, liability and staff), the powers of an INFB as well as the member states' rights and obligations. In addition there are also considerations about the order of magnitude of an INFB, store sites, powers of the international operating organization, supply and final storage as well as release of nuclear material. Finally, supervision, settlement of disputes, withdrawal, and sanctions are dealt with, as well as special problems such as storage, EURATOM membership, bilateral relations and the particular aspects of the nuclear weapons states.

The major priorities are the criteria of proliferation inhibition and assurance of supply. A balanced design which would adjust the problems both of proliferation inhibition and assurance of supply is not yet in sight. Since the discussion is still open, no clear evaluation can be made from the point of view of the Federal Republic of Germany.

Membership should be open to all recipient and supplier countries, that is to say also to those nations who do not have any uranium at their disposal. Particular emphasis will be placed on nuclear materials safeguards and physical protection of the facility at the bank site. In this connection, the question of obstacles to membership resulting from the construction or acquisition of sensitive facilities as well as consent to restrictions on the utilization of nuclear material is controversial. If the prerequisites for membership were to be applied in such a way that the Federal Republic of Germany could become a member under present boundary conditions (NPT membership, IAEA safeguards), that is to say no renunciation of the construction or acquisition of sensitive facilities and no utilization restrictions were to be required, then the bank could provide long-term advantages, since it cannot be ruled out that the market which can be supplied at the moment could in future be restricted and unbalanced by rising demand.

The economic organization of an INFB would largely depend on the question of the extent to which the bank's administrative procedures can be kept free of political influences. Since an INFB should basically also be accessible to states who cannot contribute any material then a structurally determined advantage would result in comparison to a network. However, the participation of private parties has not yet been settled and this could be more easily realized within a network.

2.2 Back End

2.2.1 Regional Fuel Cycle Centre (RFCC)

This part of the study investigates the model for a multinational fuel cycle centre, as formulated for the first time in 1977 in a project report from the IAEA on forms of organization for nuclear fuel cycle facilities.

This model envisages that several states will join together on the basis of mutually identical interests and requirements for the purpose of planning, constructing and operating nuclear facilities associated with the stages in the fuel cycle after unloading the fuel elements from the reactor. That is to say the storage of spent fuel elements, their reprocessing, the fabrication of plutonium-bearing fuel as well as the treatment of radioactive waste. This latter comprises the fields of intermediate storage, transportation and final storage. Inclusion of the front end in the fuel cycle (e.g. enrichment) has not been ruled out, but in the view of the IAEA did not have a high priority at that time.

In the Federal Republic of Germany for statutory licensing reasons the extension of nuclear power plants and their operation is subject to the proof of availability of back end services. In connection with participation in a multinational fuel cycle centre Germany would be imposed on extension of the back end in the nuclear fuel cycle under an international treaty. Whereas at the moment reprocessing in Germany is incumbent upon private operators, inclusion of the Federal Republic in an organization of this type would basically result in the transfer of the reprocessing obligation to the government.

Motivation for the formation of a multinational organization for the construction and operation of a fuel cycle centre results from the realization that the further proliferation of nuclear weapons can in the long term not solely be combatted by international nuclear materials safeguards measures. Since proliferation is a political problem, gaps in the non-proliferation scheme can in first instance be bridged by political measures. An internationalization of the nuclear fuel cycle has therefore been extensively discussed in international circles - particularly in the course of INFCE.

Internationalization comprises arrangements on the governmental level, technical support and research programmes, safeguards agreements, supply contracts and multinational cooperation agreements. It is presumed that a group of nations has a mutual interest and need in securing their energy supply by cooperation and in creating a more stable basis for confidence so that commercial nuclear technology will not be misused for the construction of nuclear weapons.

The study comes to the conclusion - in an evaluating summary of the individual legal, political, economic and organizational aspects - that neither the creation of a multinational fuel cycle centre nor the creation of an international organization for the construction and operation of such an industrial complex represent realistic approaches to solving the problem.

The size of a fuel cycle centre raises different acceptance problems for the host state since the facility will have to be designed in such a way that all member states could be supplied with back end services.

With respect to the organizational form, the multinational variant would indeed be easier to realize in contrast to the international organization but this would only be desirable in a Urenco/Centec version. In this variant of the solution each member state would operate a more or less national facility on its own territory.

Multinational cooperation with nuclear recipient countries would seem to be a solution with respect to smaller fuel cycle centres. However, this type of solution would rule out successful cooperation from the very beginning due to the concomitant problems regarding political dependence.

The study comes to the conclusion that creation of an International Excess Plutonium Storage System is a suitable institutional measure for preventing the accumulation of excess fissile material (in this case separated plutonium) while at the same time assuring the supply for the peaceful uses of nuclear energy.

2.2.2 International Spent Fuel Management (ISFM)

Internationalization of management as well as of storage of spent fuel elements has been extensively discussed as a possibility of applying institutional models in INFCE-WG6.* In this context it was ascertained that the existing legal and institutional framework for the storage and transportation of spent fuel elements was sufficient to minimize the risk of proliferation. However, it was also ascertained that there is at the moment no international legal framework which would guarantee the individual countries access to their spent fuel elements or the storage and transportation of these.

The individual elements of the model have not been discussed internationally up to now. Nevertheless, a few boundary conditions were mentioned in the INFCE which would be advantageous for the introduction of such a system, such as collocation, non-discrimination, international conciliation, safeguards, further utilization of spent fuel elements and maintenance of the reprocessing option.

This part of the study depicts internationalization of management and storage of spent fuel elements in the way it was discussed as a possibility for applying institutional models in INFCE WG6.

Realization of an international regime is analyzed from the points of view of protection against proliferation, assurance of supply, economic efficiency, assurance of planning, transfer of technology, political acceptance, the aspects of health, safety and environment, and capability to sanctions. It becomes apparent that the pessimism already expressed in the INFCE with respect to the establishment of international management for spent fuel elements is confirmed.

Present technical boundary conditions suggest the conclusion that in the immediate future no international solution for the storage of spent fuel elements will be achieved and that the nations concerned, at least insofar as they have a fairly large national nuclear energy programme, will have to provide the necessary storage capacity under exclusively national administration.

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*In 1979 the Director General of the IAEA convened a group of experts to deal with the problems of ISFM and they have not yet completed their work.

2.2.3 International Plutonium Storage (IPS)

In the commercial reactor systems used at the present time, nuclear fuel is largely applied in the U-Pu cycle. The plutonium resulting in this fuel cycle raises various problems for the further extension of nuclear energy. There are basically two possibilities in treating the problem of Pu management. The plutonium is either left in the spent fuel elements and these are brought to a corresponding store, or the spent fuel elements are taken to a reprocessing facility. In reprocessing irradiated fuels plutonium is separated. It is the primary energy carrier available for refabrication into fuel elements with respect to utilization in fast breeders. Basically, reprocessing and utilization of plutonium in nuclear reactors appears to be indispensable for industrialized countries poor in uranium. This results in plutonium management with the possibility of storage. Nevertheless, it must be presumed at the moment, on the basis of the delayed introduction of nuclear energy programmes in various countries, that reprocessing and application of the fast breeder will also only proceed slowly. Although the quantities of separated plutonium are still relatively small at present they will increase because of the extension of commercial reprocessing, at least in some countries. The concern of the international community is on the one hand to protect plutonium against misuse for constructing nuclear explosives. Comprehensive technical, safeguarding and institutional measures should be applied to achieve this aim. On the other hand, confidence should be bolstered that fissile material will continue to be available as a primary energy carrier so that world economic and social equilibrium can be encouraged.

In 1976 an internal working group of the Secretariate was commissioned by the IAEA and they worked on a comprehensive study of "International Management and Storage of Plutonium and Spent Fuel" until 1978, and investigated models for improved international cooperation in the management of irradiated fuel elements.

A group of experts from the member countries have been engaged in acquiring a better understanding of the questions involved in international plutonium storage since 1978. They are to make appropriate suggestions to the IAEA Board of Governors, with the ultimate participation of delegations from 25 nations (Expert Group on International Plutonium Storage (IPS)).

The problem of reprocessing, plutonium processing and recycling was also investigated in the INFCE discussions. According to INFCE data, the quantity of stored plutonium in spent fuel present up to the end of 1977 amounted to more than 21 tons worldwide (without the socialist countries). According to INFCE estimates, this volume amounted to over 43 tons at the end of 1980 and will reach 57 tons by the end of 1990.

The study investigates the institutional measures which could prevent the accumulation of excess separated plutonium under national administration.

The motivation in creating an IPS system is to prevent excess plutonium from accumulating, particularly separated plutonium, while at the same time assuring the supply for the peaceful uses of nuclear energy. Furthermore, in its statute the IAEA is granted the right to demand that excess fissile material be deposited. The legal basis for this is Article XII.A.5, IAEA statute:

- The fissile material is accordingly divided into two categories: The material in use and the material which exceeds the quantities required for the envisaged applications.
- Application refers to the final use of the fissile material.
- The third essential aspect is the IAEA's obligation to return the fissile material to the member state promptly on demand.

A problem is to be found in categorizing all the separated plutonium according to the material in use and excess material. In this question, the study favours the principle that each member state should be granted the right to categorize the material and thus to determine excesses.

The study suggests that, for the institutional implementation of an IPS system, that safeguards agreements between the IAEA and IPS member states should be made a prerequisite which will be supplemented by an IPS arrangement. Furthermore, nations with an IPS store shall conclude a host agreement with the IAEA. Membership in the IPS system would have to be open to all nations as well as to those international organizations who are responsible with respect to nuclear energy.

The arrangement on implementing the IPS system would have to regulate the following points which are dealt with in detail in the study:

- Registration of the separated plutonium.
  Registration of the separated plutonium would have to be accompanied by a use declaration in the initial phase of the IPS system so that it would be possible to differentiate between excess material and material in use for the safeguards authorities. Accordingly the use declaration would have to be surrendered as part of the return process.

- Depositing excess plutonium.
  In implementing the IPS system, the IAEA should require a deposit, for example in the sense that the member state be obliged always to deposit its plutonium in excess of the quantities required for the named applications in an IPS store immediately. This requirement refers to the quantity of separated plutonium for which no use declaration can be given.

- Release procedure.
  Application for release should contain the following data:
  - Specification of the IPS store from which the separated plutonium is to be taken;
  - desired quantity of plutonium;
  - required release date:
  - Specification of the facility for which the material is finally determined. The IAEA shall examine whether the application is complete in this sense and authorize return within one month.

- Verification of plutonium use.
  The IAEA shall verify plutonium use as part of its safeguards activities.

- Changes in plutonium use.
  The IAEA shall be informed in advance of changes in the planned use of plutonium and shall transfer its consent to return to the new application. Restorage of the plutonium will become necessary if no use declaration can be given for the plutonium.

- Designation of IPS stores.
  IPS stores should be located directly at a reprocessing facility or MOX fuel element factory. INFCIRC/225 should be implemented with respect to physical protection. IPS stores should not be filled to capacity in case an IPS store has to be cleared for some reason or another. Renewal or the authority to clear an IPS store should be incumbent upon the IAEA's Board of Governors.

- Distribution of responsibilities.
  The IAEA shall be responsible for safeguards and custody (permanent presence of inspectors). The host country could be owner and operator. The principles of free nuclear trade would have to be valid. Insofar as foreign material is stored, import and export of the plutonium and also operation of the IPS store must not be impeded. In a crisis the IAEA would have to have the possibility of transferring the contents of the store.
  The study indicates that an IPS commission is neither necessary nor desirable.

An IPS system conceived in this way would fulfill the principles of non-proliferation within the safeguards framework and would increase assurance of supply.

Prior consent rights as well as other bilateral reservations which impinge upon the spheres of national sovereignty, economic efficiency and planning could either be dispensed with or their effect could at least be better adjusted to the necessities of supply assurance.

3. Conclusion

With increased utilization of nuclear energy worldwide institutional mechanisms could be applied which would serve both non-proliferation and assurance of supply. Participation in a multinational fuel cycle centre would indeed have advantages at the front and back end for states with fairly small nuclear programmes. However, legal, political and organizational aspects make the realization of models of this type seem unrealistic. An international storage system for excess separated plutonium would have advantages, both with respect to non-proliferation and also assurance of supply, if for this model certain reservations could be suspended or their effects considerably reduced, for example by determining suitable conditions. A store for spent fuel elements would similarly provide advantages in supply assurance for countries with fairly small nuclear programmes. In case of interruptions in supply at the front end of the fuel cycle two emergency mechanisms are suggested. On the one hand a fuel bank, which seems to be more suitable for small consumers, as well as a uranium safety net, which could be advantageous for large-scale consumers and is characterized by great flexibility.

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